International migration, human capital formation, and saving

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ABSTRACT

In the model of Stark et al. (1997, 1998), the possibility of employment in a developed country raises the level of human capital acquired by workers in the developing country. We show that this result holds even when workers have the option to save.

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1. Introduction

The idea that the prospect of migrating to a developed, technologically advanced country, where the returns to human capital are higher than in the developing home country, induces individuals in the home country to acquire additional human capital initiated a large "New Economics of the Brain Drain" literature (Stark, 2005). The pioneering writings on this topic, Stark et al. (1997, 1998), did not deal, however, with the possibility of saving.

A natural question is whether the positive human capital formation response identified in the model of Stark et al. (1998) is robust to the introduction of saving. After all, saving is a device for obtaining less variability in one's lifetime consumption than in income or earnings, so resorting to saving may weaken or even negate the need to employ other instruments; savings could thus "crowd out" the human capital formation response. Whereas there is typically a risk in acquiring human capital,[1] savings can reasonably be assumed to yield fixed and certain returns. The facility of saving as a risk-free investment is of particular relevance for the analysis of Stark et al. (1998) because the main result there is contingent on a particular attitude of the individual towards risk - a low degree of relative risk aversion.

Both saving and human capital formation are means of investing in the future, and an optimizing individual will seek to equalize the marginal returns from them. Indeed, Azariadis and Drazen (1990), who studied the optimal education decision with an option to save, established that the marginal returns to education and saving are equalized at the interior equilibrium, and that any exogenous factor increasing the productivity of human capital raises the time spent in schooling. However, neither they nor others who pursued similar lines of inquiry (for example, Galor and Stark, 1994) incorporated the consideration of a *probable*

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[1] See Levhari and Weiss (1974) for an analysis of the riskiness of human capital formation and its consequences. In a similar vein, see also Tsiddon (1992), and Krebs (2003).

utilization of the acquired human capital in a foreign country as a feature that renders investment in human capital risky.

In this paper we ask: can the option to save neutralize ("crowd out") the effect of the prospect of migrating on human capital formation? When saving is an option, under what conditions does the prospect of migrating lead to increased investment in human capital? In particular, when saving is undertaken, does a low degree of relative risk aversion need to be replaced by a more stringent condition for the human capital formation outcome to hold?

2. A model of human capital formation, savings, and migration

Consider a workforce in a closed economy H. Members of the workforce live for two periods. In the first period, they work and can engage in human capital formation. Work is rewarded by a competitive wage, w_H, per efficiency unit of labor. The cost of forming human capital is equal to forgone earnings. To begin with, every worker is endowed with one efficiency unit of labor. Denoting by $l \in [0,1]$ the fraction of the unit endowment of labor that a worker chooses to allocate to human capital formation, first-period earnings are $(1-l)w_H$. The amount of productive human capital, measured in efficiency units of labor, that is available to a worker in the second period of his life, is given by the continuous production function of human capital, $\phi(l)$, which, for $l \in (0,1)$, is twice differentiable with $\phi'(l) > 0$ and $\phi''(l) < 0$. We further assume that $\phi(l) \geq 1$ holds for all $l \in [0,1]$, that $\lim_{l \to 0} \phi'(l) = \infty$, that $\lim_{l \to 1} \phi'(l) = 0$, and that human capital does not depreciate. The second-period earnings of the worker are $\phi(l)w_H$.

The worker saves a fraction s of his first-period earnings, $(1-l)w_H$. We assume that $s \in [0,1]$. This assumption means that borrowing (incurring debt) in order to finance human capital formation, namely that $s < 0$, is not allowed.

Assume now that migration in the second period becomes a possibility, such that with probability $p \in [0,1)$ an H country worker obtains employment in foreign country F. Otherwise, the worker works in H with whatever human capital he has acquired. Human capital is perfectly transferable across countries. To reflect the fact that the foreign country is rich and the home country is poor, it is assumed that the competitive wage per efficiency unit of labor in the foreign country, w_F, exceeds the competitive wage per efficiency unit of labor in the home country, w_H. Wages in H and in F are independent of migration (that is, migration is relatively small), and the rate of return on savings, $r \geq 0$, is exogenously given. Let $\delta = 1 + r$. Then, the worker's income in the second period will be $\phi(l)w_H + \delta s(1-l)w_H$ if he works in H, and $\phi(l)w_F + \delta s(1-l)w_H$ if he ends up working in F.

Per period utility, which is given by the function $U(x)$, is derived from periodic consumption, x. The function $U(x)$ is twice differentiable with $U'(x) > 0$ and $U''(x) < 0$ for all $x \geq 0$.

The worker's optimization problem involves choosing l and s that maximize his intertemporal utility

$$V\big((l,s),p\big) = U\big((1-s)(1-l)w_H\big)$$
$$+ \rho\big[pU\big(\phi(l)w_F + \delta s(1-l)w_H\big)$$
$$+ (1-p)U\big(\phi(l)w_H + \delta s(1-l)w_H\big)\big] \quad (1)$$

where $\rho \in (0,1]$ is the worker's subjective time rate of discount.

We assume that $\lim_{x \to 0} U'(x) > \rho \delta U'(w_H)$ or, alternatively, that $\lim_{x \to 0} U'(x) = \infty$, which implies that the worker does not save his entire first-period income. Given the limit properties of the production function of human capital, and given the properties of the utility function, the fraction of the endowment of labor allocated to human capital formation is positive, but less than one, namely $l \in (0,1)$.

The model of Stark et al. (1998) is a special case of the model described above without a possibility of saving, namely, in the Stark et al. (1998) model the worker maximizes (1) under the constraint $s = 0$. Then, Stark et al. (1998) show that if the condition $w_F U'(\phi(l)w_F) > w_H U'(\phi(l)w_H)$ is fulfilled for all l, the optimal level of human capital is higher in the presence of a prospect of migrating than in its absence. Any utility function $U(x)$ such that $xU'(x)$ is an increasing function of x, at least for $x \in [\phi(0)w_H, \phi(1)w_F]$, fulfills this condition. Examples of such functions are $U(x) = \ln(x+1)$, and $U(x) = x^\alpha$ where $\alpha \in (0,1)$. Assuming this condition is tantamount to assuming that the worker's preferences exhibit a coefficient of relative risk aversion (RRA) that is less than one, namely that $RRA(x) = \frac{-xU''(x)}{U'(x)} < 1$. Intuitively, for a worker to engage in the risky ($p < 1$) acquisition of more human capital in anticipation of the high returns to human capital available in the foreign country only to end up not migrating and not reaping those returns, the worker has to exhibit low aversion to risk.

To streamline notation, we denote the worker's consumption as follows: in the first period, by c_0; in the second period by c_F if the worker migrates, and by c_H if the worker stays in the home country. Thus, $c_0 = (1-s)(1-l)w_H$; $c_F = \phi(l)w_F + \delta s(1-l)w_H$; and $c_H = \phi(l)w_H + \delta s(1-l)w_H$.

We obtain the properties of the solutions to the maximization problem that follows from (1) upon drawing on the necessary Karush-Kuhn-Tucker conditions, which are determined by the derivatives of (1) with respect to l and s, namely, by

$$V_l\big((l,s),p\big) = -(1-s)w_H U'(c_0)$$
$$+ \rho\big[p\big(\phi'(l)w_F - \delta s w_H\big)U'(c_F)$$
$$+ (1-p)\big(\phi'(l)w_H - \delta s w_H\big)U'(c_H)\big] \quad (2)$$

and

$$V_s\big((l,s),p\big) = (1-l)w_H\big\{-U'(c_0) + \rho\delta\big[pU'(c_F) + (1-p)U'(c_H)\big]\big\}, \quad (3)$$

respectively. Because we can restrict our attention to the case of $l \in (0,1)$, it follows from (3) that $V_s\big((l,s),p\big)$ has the same sign as $\big\{-U'(c_0) + \rho\delta\big[pU'(c_F) + (1-p)U'(c_H)\big]\big\}$. We denote the pair (l,s) that maximizes (1) as (l^p, s^p). Then, c_i^p is c_i, $i = 0, F, H$ taken for $(l,s) = (l^p, s^p)$.

The effect of the probability p of migrating on human capital formation is $E^p = l^p - l^0$. We denote by $\tilde{l}^p$ the optimal fraction of labor endowment allocated to human capital formation in the model of Stark et al. (1998). Without an option to save, the effect of a probability of migrating on human capital formation is $\tilde{E}^p = \tilde{l}^p - \tilde{l}^0$.

We first formulate a lemma which allows us to characterize the optimal fraction of the endowment of labor allocated to human capital formation in terms of the relationship between the marginal returns to the fraction of the endowment of labor allocated to human capital formation at the optimum, namely, $\phi'(l^p)$, and the marginal returns to savings, δ. When migrating is not possible ($p = 0$), both human capital formation and saving are riskless. We expect the worker to form human capital up to the point at which a further increase in future consumption is not desirable, or up to the point at which the marginal returns from investment in human capital are equal to those that accrue from saving. When migrating is a possibility ($p > 0$), the marginal returns from investment in human capital are uncertain: the returns to be reaped from human capital are either low, $\phi(l^p)w_H$, or high, $\phi(l^p)w_F$. With s^0 and s^p standing, respectively, for the optimal level of saving when the economy is closed and when migration is possible ($p > 0$), we have the following lemma.

Lemma 1.
I. If $s^0 = 0$, then $\phi'(l^0) \geq \delta$; namely, when migrating is not possible, if the worker does not save, then, at the optimum, the marginal